

8.2.4.2 Basic Principles of Financial System for Individual Municipal SWM

a. Key Issues to Improve

With an aim to consolidate financial sustainability of municipal SWM services, the following are listed as key issues for the improvement:

- Introduction and execution of independent accounting of SWM;
- Revision and improvement of tariff structure and fee collection system;
- Consolidation and utilization of SWM database;
- Expenditure monitoring and its feedback for cost reduction improvement;
- Human resource development and computer use for accounting; and
- Use of private sector.

a.1 Independent Accounting

In order to execute sustainable SWM services, it is necessary to establish an accounting system of not only controlling revenue and expenditure but also enabling the proper investment for renewal of vehicle etc. by having a depreciation reserve. Accounting of SWM services independent of the municipal general accounting is indispensable to do so.

If the municipal general accounting in any municipality does not have sectional division of SWM expenses and other expenses, such municipality should immediately establish the accounting with sectional divisions.

a.2 Tariff Structure and Fee Collection System

It is proposed to improve the current tariff structure and fee collection system to a new ones reminding the following key issues:

- **generator pays principle:** who generates wastes should pay for the costs of waste management services:
- **affordable fee collection:** the least affordable users should pay lesser for the service, and the more affordable should pay more for the services. It may consequently constitute a cross-subsidy system that should be fairly acceptable for all.
- **minimization of fee collection costs:**
 - efficient and imperative fee collection system (**joint billing** with electricity charges)
 - appropriate fees for specialized SWM services (e.g., **specific duty** system: fee rate proportional to waste volume)

Accordingly, following actions might be suggested:

- Cleansing fee (tasa de aseo), which are currently charged in proportion to real estate size, should be collected through the joint billing with electricity charges. In so doing, cleansing fee collection efficiency should be targeted to raise up to 90% till year 2010.
- Municipalities that have not yet collected the landfill fee (tasa de relleno), should

establish the tariff structure that includes the fee collection from citizens that do not own real estate.

- The fee rate for the marginal low income citizen should consider their affordability to pay.
- A specific duty system (fee rate proportional to waste volume) should be applied for the larger commercial/institutions waste. Smaller commercial/institutions such as small shops would be exempted from the specific duty system and be subject to the same system for the households. In order to minimize the fee collection costs, joint billing with electricity charges should be used for the fee collection system.

a.3 Database Management

All municipalities should establish and/or consolidate the database of fee collection (both cleansing fee and landfill fee). Such municipal database should be linked with the database of CAESS/DELSUR, especially when some municipalities start the joint billing of cleansing fee, in order to be able to monitor the fee collection efficiency (e.g., delayed payment, update of users, etc.).

a.4 Expenditure Monitoring and its Feedback for Cost Reduction Improvement

Database of weighbridge should be linked for monitoring the efficiency of waste collection services. The monitoring should be utilized for planning and implementation of collection work improvement etc.

Expenditure respectively for collection vehicle and/or collection team should be thoroughly monitored and respective cost-efficiency should be reviewed. Personal costs, working hours, fuel/lubricant consumption, maintenance record and waste collection amount should be monitored and induce respective productivity for comparison and improvement.

a.5 Human Resource Development and Computer Use for Accounting

In order to improve the above mentioned revenue/expenditure management, human resource development for accounting and computer works should be expedited. Collaboration of the accounting manager and cleansing office manager should be indispensable for this revenue/expenditure management and improvement. Accordingly the cleansing office manager could take actions for rationalize the human and physical resources of the cleansing services.

a.6 Use of Private Sector

Case-by-case reviews should be made for examining the viability of private sector participation in collection service activities. The examination should always investigate the pros and cons of these alternatives e.g., whether and how the private participation reduces or increases the municipal burden of SWM services.

b. Expenditure Estimation

In order to estimate the total expenditure of municipal SWM by respective municipalities till the year 2010, it is necessary to internalize the costs of regional SWM projects proposed in the M/P. Therefore, unit rates for respective regional projects of T/Ss, Tonacatepeque S/L, New ESPIGA S/L, S/P etc. are estimated as

shown below, with reference to unit cost estimations from case studies assumed and as summarized in Table 8-30.

Table 8-31: Regional Projects Unit Rate to be Internalized for Respective Municipal Expenditures

		Unit Price	Remarks
Transfer Station	T/S 1 (350 t/d)	7.0US\$/ton	In proportion to deposited amount (from year 2004)
	T/S 2 (900 t/d)	5.8US\$/ton	Ditto above (from year 2005)
Intermediate treatment	S/P	27.2US\$/ton	In proportion to amount of recyclable materials deposited (from year 2008)
Landfill*	MIDES Nejapa	20.43US\$/ton (18US\$/ton+VAT)	In proportion to amount disposed (from year 2001)
	Tonacatepeque	20.2US\$/ton	Ditto above (from year 2005)
	New ESPIGA**	20.2US\$/ton	Ditto above (from year 2004)
Medical waste treatment	MIDES Nejapa	200US\$/ton+VAT	These costs are not reflected for municipal expenditures.
	Incineration	390US\$/ton	

Note: * The present costs for ESPIGA is assumed to be 5 US\$/ton, and the present costs of open dumping (SMT, TN) is assumed to be 1 US\$/ton.

** As the tipping fee of the New Espiga S/L is unknown, it is assumed to be same as that in Tonacatepeque S/L.

In addition to the expenditures estimated based on the above unit rates, an indirect expenditure for operating the Execution Unit in OPAMSS is estimated to be about 80,000US\$/year and is proportionally distributed for respective municipalities as their indirect costs.

Accordingly the expenditure of SWM services for 14 municipalities till year 2010 is estimated as summarized in the table below.

Table 8-32: Summary of Expenditure of Individual Management System

Unit : 1,000 colones

		Phase I	Phase II	Phase III	Total	
SS	Investment	50,157	6,168	56,252	112,577	
	O&M	Disposal	100,497	112,134	165,674	378,305
		Collection	68,495	58,679	79,546	206,720
		T/S	0	19,994	37,983	57,977
		Others*	117,963	120,840	164,072	402,875
	O&M total	286,955	311,647	447,275	1,045,877	
	Total	337,112	317,815	503,527	1,158,454	
MJ	Investment	6,094	705	6,974	13,773	
	O&M	Disposal	14,615	15,829	22,672	53,116
		Collection	8,799	7,760	10,029	26,588
		T/S	0	3,011	6,384	9,395
		Others*	6,097	6,465	9,227	21,789
	O&M total	29,511	33,065	48,312	110,888	
	Total	35,605	33,770	55,286	124,661	
CD	Investment	3,369	873	3,377	7,619	
	O&M	Disposal	6,314	6,855	9,837	23,006
		Collection	3,790	4,132	5,966	13,888
		T/S	0	0	0	0
		Others*	4,439	4,726	6,732	15,897
	O&M total	14,543	15,713	22,535	52,791	
	Total	17,912	16,586	25,912	60,410	
CT	Investment	2,504	0	3,369	5,873	
	O&M	Disposal	2,956	6,614	9,513	19,083
		Collection	4,060	3,300	3,916	11,276
		T/S	0	1,124	2,384	3,508
		Others*	3,191	3,526	5,287	12,004
	O&M total	10,207	14,564	21,100	45,871	
	Total	12,711	14,564	24,469	51,744	
AY	Investment	896	8	896	1,800	
	O&M	Disposal	2,108	2,291	3,294	7,693
		Collection	1,220	1,378	1,957	4,555
		T/S	0	0	0	0
		Others*	1,117	1,194	1,717	4,028
	O&M total	4,445	4,863	6,968	16,276	
	Total	5,341	4,871	7,864	18,076	
SM	Investment	3,369	15	3,377	6,761	
	O&M	Disposal	6,458	7,018	10,095	23,571
		Collection	5,365	4,089	4,680	14,134
		T/S	0	1,351	2,867	4,218
		Others*	1,763	1,809	2,475	6,047
	O&M total	13,586	14,276	20,117	47,979	
	Total	16,955	14,291	23,494	54,740	
ST	Investment	7,687	880	8,583	17,150	
	O&M	Disposal	17,713	19,139	27,336	64,188
		Collection	13,617	8,623	12,548	34,788
		T/S	0	6,470	9,233	15,703
		Others*	8,158	8,456	11,849	28,463
	O&M total	39,488	42,688	60,966	143,142	
	Total	47,175	43,568	69,549	160,292	

		Phase I	Phase II	Phase III	Total	
AC	Investment	4,272	15	4,295	8,582	
	O&M	Disposal	4,641	10,090	14,682	29,413
		Collection	6,638	4,023	5,929	16,590
		T/S	0	3,336	4,932	8,268
		Others*	6,069	6,633	9,210	21,912
	O&M total	17,348	24,082	34,753	76,183	
	Total	21,620	24,097	39,048	84,765	
SY	Investment	12,832	53	13,751	26,636	
	O&M	Disposal	29,034	32,042	46,855	107,931
		Collection	19,092	15,553	19,119	53,764
		T/S	0	5,799	12,953	18,752
		Others*	5,768	6,108	8,933	20,809
	O&M total	53,894	59,502	87,860	201,256	
	Total	66,726	59,555	101,611	227,892	
IL	Investment	4,272	15	5,153	9,440	
	O&M	Disposal	9,048	9,838	14,200	33,086
		Collection	6,874	5,510	6,620	19,004
		T/S	0	1,867	4,020	5,887
		Others*	2,564	2,783	4,032	9,379
	O&M total	18,486	19,998	28,872	67,356	
	Total	22,758	20,013	34,025	76,796	
SMT	Investment	2,489	873	2,489	5,851	
	O&M	Disposal	739	3,949	7,856	12,544
		Collection	2,082	2,747	4,335	9,164
		T/S	0	0	0	0
		Others*	829	1,812	2,952	5,593
	O&M total	3,650	8,508	15,143	27,301	
	Total	6,139	9,381	17,632	33,152	
AP	Investment	4,288	865	4,310	9,463	
	O&M	Disposal	9,467	10,281	14,755	34,503
		Collection	4,600	5,047	7,286	16,933
		T/S	0	0	0	0
		Others*	3,689	4,054	5,990	13,733
	O&M total	17,756	19,382	28,031	65,169	
	Total	22,044	20,247	32,341	74,632	
NJ	Investment	880	0	880	1,760	
	O&M	Disposal	988	1,076	1,554	3,618
		Collection	647	800	1,162	2,609
		T/S	0	0	0	0
		Others*	207	350	504	1,061
	O&M total	1,842	2,226	3,220	7,288	
	Total	2,722	2,226	4,100	9,048	
TN	Investment	1,799	0	2,489	4,288	
	O&M	Disposal	214	3,283	6,850	10,347
		Collection	1,845	2,003	2,995	6,843
		T/S	0	0	0	0
		Others*	609	905	1,315	2,829
	O&M total	2,668	6,191	11,160	20,019	
	Total	4,467	6,191	13,649	24,307	

Note: * including street sweeping, administration, workshop and S/P.

c. Revenue Plan

c.1 Stepwise Improvement

The following stepwise improvement measures are proposed. The table below shows financial improvement of total balance during 2001 to 2010 when the proposed improvement measures are taken place in a stepwise manner.

- **Fee collection efficiency improvement by joint billing with electricity charges:** As for landfill fee (tasa de relleno), many municipalities utilize the system of joint billing with electricity charges. However, a few municipalities have the joint billing system for the cleansing fee (tasa de aseo). All fees should be jointly billed with electricity charges from year 2003. Fee collection efficiency will be gradually raised up to 90% in year 2010 from the present one. It will also reduce the delayed payment by users.
- **Specific duty system:** A specific duty system (fee rate proportion to waste volume) will be applied for commercial/institutions waste from year 2002. Assuming that 50% of such waste is from large dischargers, the fee rate for such dischargers is to cover the direct costs of collection/transport services (including vehicle depreciation costs) and the landfill tipping fee.

Table 8-33: Income Improvement of Total Balance until year 2010 by Adopting Respective Measures

Unit :1,000 colones

	Balance without measures	Measures 1 Balance improvement after "joint-billing with electricity" and "Fee collection rate increase"	Measures 2 Further balance improvement after "specific duty on large dischargers"
San Salvador	121,217	180,526	- ditto -*
Mejicanos	-17,179	8,160	- ditto -*
Delgado	355	9,441	14,375
Cuscatancingo	-22,047	-18,379	-15,195
Ayutuxtepeque	3,713	7,392	8,732
San Marcos	-21,931	-13,400	-10,192
Nueva San Salvador	73,368	93,594	100,813
Antiguo Cuscatlan	-37,872	-32,633	-27,457
Soyapango	-39,668	-9,795	8,886
Ilopango	8,750	17,869	- ditto -*
San Martin	-5,962	-2,320	503
Apopa	-7,241	1,606	6,347
Nejapa	-5,449	-3,665	-3,416
Tonacatepeque	-19,607	-18,076	-16,386

The above table shows that even the respective measures proposed are to be realized, municipalities of Cuscatancingo, San Marcos, Antiguo Cuscatlan, Nejapa, and Tonacatepeque will still remain in negative figures in the total balance until year 2010.

For these municipalities, the succeeding measures could be one or both of: (i) to raise the services fee that users should pay; and/or (ii) to demand a national subsidy to

counterbalance the additional costs necessitated to comply with the recently published national environmental legislation.

c.2 Possibility to Raise Service Fee and Burden on Citizen's Income

Trial calculation is made herewith to obtain the minimum increase of service fee to make the total balance of 2001 to 2010 just a little positive. It assumed that the service fee is raised in year 2006. The raised fees for the respective municipalities are measured with the parameter of the burden on citizen's income (BCI) in 2010 accordingly. (See the table below.)

Table 8-34: Minimum Increase of Fee and its Burden on Citizen's Income

Year	Increase rate of Cleansing tax (%)	Total Balance (1,000 colones)	Average waste taxes (cleansing tax + disposal tax) (colon/month/ household)	Burden on Citizen's Income (%)
	2006	2001 – 2010	2010	2010
Cuscatancingo	88 %	101	15.3	0.33
San Marcos	82 %	38	18.9	0.29
Antiguo Cuscatlan	90 %	289	45.3	0.37
Nejapa	127 %	7	19.4	0.52
Tonacatepeque	552 %	20	26.9	0.82

In view of the above trail calculation, it seems very difficult for Tonacatepeque municipality to raise the service fee as high as 6.5 times of the present fee suddenly in year 2006. Therefore, the M/P proposes that Tonacatepeque municipality raises the service fee double in 2003 when joint billing with electricity is adopted, and then again in 2006 said fee should be raised to its about three-fold value.

If the revenue improvement measures described above are implemented, the fee collection rate and total annual revenue of the SWM service as shown in the table below can be achieved in respective phase end years (2003, 2006 and 2010).

Table 8-35: Revenue Plan

Unit: 1,000 colones

		1999	2003	2006	2010
SS	Tax collection rate (%)	83	85.5	87.5	90
	Total amount	96,839	121,829	136,351	156,222
MJ	Tax collection rate (%)	65	77.3	82.7	90
	Total amount	7,152	11,846	13,715	16,190
CD	Tax collection rate (%)	70	77.3	82.7	90
	Total amount	3,906	6,754	7,714	8,962
CT	Tax collection rate (%)	72	77.3	82.7	90
	Total amount	2,100	3,077	6,341	7,674
AY	Tax collection rate (%)	79	83	86	90
	Total amount	1,321	2,379	2,793	3,370
SM	Tax collection rate (%)	83	85.5	87.5	90
	Total amount	2,394	4,181	6,604	7,666
ST	Tax collection rate (%)	85	86.8	88.2	90
	Total amount	16,110	22,937	26,769	32,166
AC	Tax collection rate (%)	70	77.3	82.7	90
	Total amount	3,191	4,894	10,819	13,923
SY	Tax collection rate (%)	70	77.3	82.7	90
	Total amount	13,194	21,424	24,285	28,616
IL	Tax collection rate (%)	85	86.8	88.2	90
	Total amount	5,357	8,653	9,755	11,224
SMT	Tax collection rate (%)	60	79.1	84.5	90
	Total amount	1,553	2,731	3,568	4,539
AP	Tax collection rate (%)	83	85.5	87.5	90
	Total amount	3,981	7,355	8,423	9,875
NJ	Tax collection rate (%)	50	77.3	82.7	90
	Total amount	250	529	1,254	1,458
TN	Tax collection rate (%)	55	77.3	82.7	90
	Total amount	276	1,073	3,635	4,383

In order to realize the fee collection rate and amount mentioned above, it is necessary not only to establish and utilize the revenue database, but also to implement specific duty system for large commercial/institution dischargers and to issue a demand letter for delayed payment etc.

c.3 Cash Flow of Each Municipality

With above measures proposed for revenue improvement, the total balance of revenue/expenditure during 2001 to 2010 will become positive for all 14 municipalities. As for some municipalities such as Mejicanos, Delgado, Soyapango, Ilopango, San Martin, Apopa, Nejapa and Tonacatepeque, the annual balance will become negative in some years such as year 2010 when collection vehicles are renewed. However, as the total balance during 2001 to 2010 will become positive also for those municipalities, it would be judged that sustainable financial system in SWM services will be maintained.

Table 8-36: Financial Status in 2010

Unit: 1,000 colones, %

	Balance of SWM in 2010			Burden on Municipal Budget in 2010 (%)	Burden on Citizen	
	Revenue (1,000 colones)	Costs* (1,000 colones)	Covering rate R/C (%)		Average waste tax (colon/month /household)	Burden on Citizen's Income (%)
San Salvador	156,222	123,326	127	0.0	45.8	0.47
Mejicanos	16,190	13,526	120	5.0	18.8	0.26
Delgado	8,962	5,792	155	0.4	11.9	0.22
Cuscatancingo	7,674	5,642	136	0.0	15.3	0.33
Ayutuxtepeque	3,370	1,932	174	0.0	21.5	0.41
San Marcos	7,666	5,650	136	0.0	18.9	0.29
Nueva San Salvador	32,166	16,819	191	0.0	28.5	0.35
Antiguo Cuscatlan	13,923	9,844	141	0.0	47.2	0.38
Soyapango	28,616	24,835	115	7.5	18.7	0.26
Ilopango	11,224	8,173	137	5.7	17.6	0.34
San Martin	4,539	4,441	102	15.9	9.7	0.33
Apopa	9,875	7,963	124	6.8	10.4	0.26
Nejapa	1,458	954	153	1.6	19.4	0.52
Tonacatepeque	4,383	3,222	136	2.0	24.9	0.76

Note: * direct cost including depreciation cost.

8.2.5 Social Aspect (Sanitary Education and Public Participation)

The sanitary education is an important component in SWM. It is well known that the constant presence of waste confined in a densely populated area with faulty practices on hygiene and inadequate waste handling has serious impacts on health of the inhabitants. Therefore, the public should be informed of the potential risks and illness caused by direct contact with waste and inappropriate procedures of waste handling.

Another important reason for providing sanitary education is to let the public be aware of their individual responsibility regarding health improvement and proper handling of waste.

An informed citizen is more likely to take initiatives in waste minimization, recycling programs in the communities; and change in the consumption patterns and they are more likely to pass their knowledge and experiences to the future generations. That is to say, the introduction of the sanitary education and the public participation would open the road to achieve a final goal of this study: the application of an appropriate waste management.

The table below summarizes the program of sanitary education and public participation that the Execution Unit could implement in the period from 2001 to 2010.

Table 8-37: Program of Sanitary Education and Pubic Participation (Draft)

Phase 1 2001 – 2003	Phase 2 2004 – 2006	Phase 3 2007 - 2010	Post Phase 2011
<ul style="list-style-type: none"> • Constitution of the Central Execution Unit and Units inside the municipalities • Formation or consolidation of communal associations • Preparation of educational projects with the participation of pertinent organizations • Information to the community • Sensitization and practices • Beginning of the educational program for specific areas • Personnel's training (social promoters and teachers) 	<ul style="list-style-type: none"> • Intensive education in specific areas • Education to the community through training workshops • Promotion of the sanitary education in schools 	<ul style="list-style-type: none"> • Continuation of the intensive education • Continuation of the training program • Follow-up of implemented projects • Intermediate evaluation (2006) • Interim readjustment of the program 	<ul style="list-style-type: none"> • Final evaluation (2011) • Readjustment to the program of sanitary education and public participation

8.3 Project Cost Estimates

8.3.1 Basic Conditions

This section presents key design data, unit costs and other basic conditions for project cost estimates.

The prices and foreign exchange rates are based on them in April 2000. OPAMSS, the 14 municipalities and Fondo de Inversion Social para el Desarrollo Local de El Salvador are information sources.

8.3.1.1 Exchange Rates

US\$1.00 = 8.75 colones = JP¥105

8.3.1.2 Service Life

Vehicles & Equipment: 7 years

Transfer Station *: 20 years

* Integrated service life of the facilities including buildings, machines and so on necessary.

8.3.1.3 Key Design Data

Bulk density at generation source: 200 kg/m³

Working hour: 7.5 hours/capita/day

8.3.1.4 Unit Costs

Table 8-38: Unit Costs

Description	Unit	Unit cost	
		colon	US\$
Personnel			
manager	man.year	70,000	
engineer	man.year	60,000	
supervisor	man.year	40,000	
mechanic	man.year	50,000	
mechanic assistant	man.year	40,000	
driver	man.year	35,000	
worker	man.year	32,000	
secretary	man.year	30,000	
sweeper	man.year	30,000	
Earthwork			
machine excavation, 200m transport and stockpiling	m ³	20	
machine excavation, 500m transport and stockpiling	m ³	30	
machine excavation, 1,000m transport and stockpiling	m ³	40	
construction of embankment, machine filling and compaction	m ³	90	
s/t synthetic liner (HDPE) t=1mm	m ²		2.00
s/t synthetic liner (HDPE) t=2mm	m ²		3.00
Installation of synthetic liner (HDPE) t=1mm	m ²	3	
Installation of synthetic liner (HDPE) t=2mm	m ²	3	
s/t geotextile	m ²		0.80
s/t geonet	m ²		2.50
s/t soil	m ³	50	
Drainage			
s/t/p 100mm PVC-drainage pipe (earthwork is not included)	m	95	
s/t/p 200mm PVC-drainage pipe (earthwork is not included)	m	170	
s/t/p 300mm PVC-drainage pipe (earthwork is not included)	m	370	
s/t/p 300mm concrete pipe (earthwork is not included)	m	55	
s/t/p 400mm concrete pipe (earthwork is not included)	m	65	
s/t/p 500mm concrete pipe (earthwork is not included)	m	130	
Building			
s/t/p premixed concrete 180kg/cm ²	m ³	650	
s/t/p premixed concrete 210kg/cm ²	m ³	670	
s/t/p premixed concrete 280kg/cm ²	m ³	800	
Office building R/C including all works	m ²	3,500	
Workshop, steel structure	m ²	2,500	
Floor (reinforced concrete, 210kg/cm ²)	m ²	1,200	
Roof (slate covered)	m ²	100	
Wall (block)	m ²	100	

Description	Unit	Unit cost	
		colon	US\$
Road work			
s/t/p concrete road pavement (t=0.15m)	m ²	100	
s/t/p hot-mix asphalt road pavement (t=0.1m)	m ²	90	
s/t/p gravel road (t=0.3m) and subgrade preparation	m ²	60	
Miscellaneous			
weighbridge, 60 ton, with computerized data log system	set		60,000
s/t/p plant trees 2 to 5m in height	tree	50	
s/t/p fence (timber pole H=2.5m, barbed wire)	m	20	
s/t/p gabion, 0.5m x 0.5m x 2m	m ³	380	
s/t/p gas removal pipe, 200mm perforated HDPE	m	200	
Basic materials			
diesel oil	gallon	9	
gasoline	gallon	15	
crushed rock	m ³	185	
sand	m ³	65	
reinforced bar	ton	5,000	
Equipment (brand-new)			
Refuse collection compactor truck 19 m ³ (25yd ³)	unit		85,000
Refuse collection compactor truck 14 m ³ (18yd ³)	unit		75,000
Refuse collection compactor truck 8 m ³ (11yd ³)	unit		65,000
Dump truck (6ton)	unit		50,000
Dump truck (10ton)	unit		70,000
Tractor-trailer 20t	unit		120,000
Water-tank truck (15,000liter)	unit		105,000
Water-tank truck (10,000liter)	unit		65,000
Road sweeper	unit		100,000
Wheel loader (100kw)	unit		120,000
Wheel loader (70kw)	unit		85,000
Bulldozer (100kw)	unit		125,000
Fork lift (40kw)	unit		27,000
Excavator (100kw)	unit		150,000
Excavator (75kw)	unit		115,000
Container (2m ³)	unit		700
Handcart	unit	600	

8.3.2 Cost Estimation

8.3.2.1 Regional Management System

a. Transfer Station

a.1. Outline of Facility

Outline of facility of the transfer stations is shown below.

Table 8-39: Outline of Transfer Station Facilities

Facility	T/S-1	T/S-2
Transfer capacity	350 ton/day	900 ton/day
Operation day	312 days (7.5 hours/day, 6 days/week, 52 weeks)	
Site area	8,000 m ²	12,500 m ²
Building	2,400 m ²	3,500 m ²
Pavement	5,000 m ²	8,000 m ²
Weighbridge	2 units	2 units
Hopper	3 units	9 units

b. Transfer Transport

b.1. Equipment

For transporting waste from the transfer stations to the disposal sites efficiently, 20ton tractor-trailer is used. Required number of the vehicle is calculated based on waste amount transported per day and the following conditions:

Equipment:	Tractor-trailer
Payload:	20 ton
Net working rate:	90%
Number of trips:	3 times/day
Operation day:	312 days (7.5 hours/day, 6 days/week, 52 weeks/year)

Purchase of vehicles

T/S-01:	6 vehicles in 2003 7 vehicle in 2010
T/S-02:	15 vehicles in 2004 1 vehicle in 2008 1 vehicle in 2010

c. Selection Plant

c.1 Outline of Facility

Outline of the separation plant facilities is shown below.

Table 8-40: Outline of Facility

Processing capacity	50 ton/day
Daily working time	7.0 hour/day
Sorting item	steel, aluminum, Glass, paper, plastic, etc.
Sorting method	magnetic separation and hand picking
Site area	approximate 1,300 m ²
Building area	approximate 830 m ²

d. Landfill

d.1 Outline of Facility

d.1.1 Location

It is supposed that the new landfill site (Tonacatepeque Landfill Site) would be located in the northwest of Tonacatepeque.

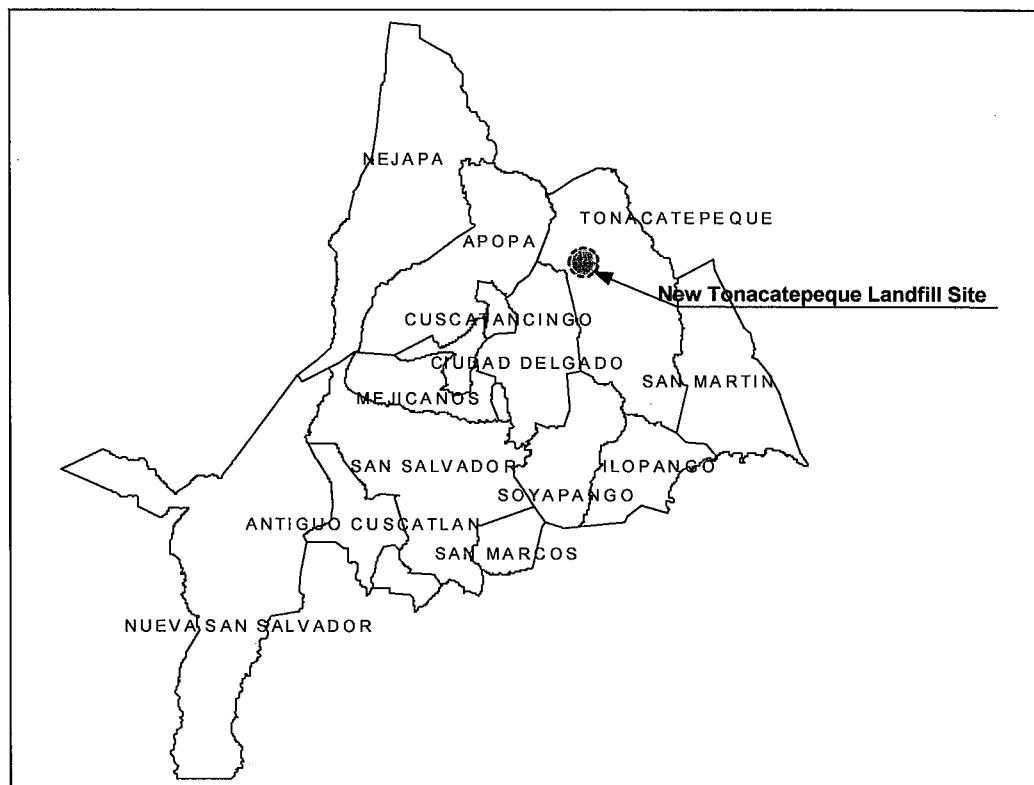


Figure 8-16: Location of Tonacatepeque Landfill Site

d.1.2 Outline of Facility

Outline of Tonacatepeque Landfill Site is shown below.

Table 8-41: Outline of Tonacatepeque Landfill Site

Name	New Tonacatepeque Landfill Site
Type of landfill	Sanitary landfill with leachate treatment
Site area	approximate 20 ha
Landfill capacity	approximate 433,000 ton (exc. cover soil)
Type of liner	HDPE liner
Leachate treatment method	Aerated lagoon and oxidation pond
Landfill equipment	Bulldozer, Dump truck, Waste truck, etc

e. Medical Waste Incinerator

e.1 Outline

The generation amount of medical waste from the AMSS in the target year (2010) is 3.98 ton/day in total. This figure, however, accounts for only the net volume of infectious medical waste. It is necessary for planning the incineration facility to consider for adding marginal capacity (such as container volume to be incinerated together). Based on empirical data and information, considering a 50% marginal capacity herewith, the planned incineration amount is set as 6.0ton/day.

e.1.1 Incineration Plan Capacity

The incineration plant will have one lines, in consideration of safety aspects, and the plant will operate for 24 hours in order to reduce environmental pollution by the gaseous emissions. The plant will operate for 312 days/year, in order to account for safety inspections several times a year.

The hourly incineration capacity of one line is calculated as follows:

$$0.30 \text{ ton/hour } (= 6.0 \times 365 / 312 / 1/24)$$

f. Overall Cost

Overall cost required for the regional management between 2001 and 2010 is shown below. It should be noted that the overall cost does not include disposal fee for Nejapa SL, MIDES and New Espiga SL.

Table 8-42: Overall Cost

Unit: US\$ 1,000

		Year	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	Total
Transfer station													
TS 1	Investment												
	Land acquisition		0	183	0	0	0	0	0	0	0	0	183
	Design & supervision		71	44	42	0	0	0	0	0	0	0	157
	Construction		0	0	1,310	0	0	0	0	0	0	0	1,310
	Equipment		0	0	255	0	0	0	0	0	0	0	255
	total		71	227	1,607	0	0	0	0	0	0	0	1,905
	O&M		0	0	0	94	94	94	94	94	94	94	94
Total		71	227	1,607	94	94	94	94	94	94	94	94	2,563
TS 2	Investment												
	Land acquisition		0	286	0	0	0	0	0	0	0	0	286
	Design & supervision		33	89	40	61	0	0	0	0	0	0	223
	Construction		0	0	769	1,154	0	0	0	0	0	0	1,923
	Equipment		0	0	0	303	0	0	0	0	0	0	303
	total		33	375	809	1,518	0	0	0	0	0	0	2,735
	O&M		0	0	0	0	139	139	139	139	139	139	139
Total		33	375	809	1,518	139	139	139	139	139	139	139	3,569
Total	Investment												
	Land acquisition		0	469	0	0	0	0	0	0	0	0	469
	Design & supervision		104	133	82	61	0	0	0	0	0	0	380
	Construction		0	0	2,079	1,154	0	0	0	0	0	0	3,233
	Equipment		0	0	255	303	0	0	0	0	0	0	558
	total		104	602	2,416	1,518	0	0	0	0	0	0	4,640
	O&M		0	0	0	94	233	233	233	233	233	233	233
Total		104	602	2,416	1,612	233	233	233	233	233	233	233	6,132

		Year	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	Total
Transfer transport													
TS 1	Investment												
	Design & supervision	0	0	45	0	0	0	0	0	0	0	52	97
	Equipment	0	0	895	0	0	0	0	0	0	0	1,044	1,939
	total	0	0	940	0	0	0	0	0	0	0	1,096	2,036
	O&M	0	0	0	218	222	229	237	241	249	253	1,649	1,649
Total	0	0	940	218	222	229	237	241	249	253	1,349	3,685	
TS 2	Investment												
	Design & supervision	0	0	0	112	0	0	0	8	0	0	8	128
	Equipment	0	0	0	2,237	0	0	0	149	0	0	149	2,535
	total	0	0	0	2,349	0	0	0	157	0	0	157	2,663
	O&M	0	0	0	0	557	576	591	607	622	637	3,590	3,590
Total	0	0	0	2,349	557	576	591	764	622	794	6,253	6,253	
Total	Investment												
	Design & supervision	0	0	45	112	0	0	0	8	0	0	60	225
	Equipment	0	0	895	2,237	0	0	0	149	0	0	1,193	4,474
	total	0	0	940	2,349	0	0	0	157	0	0	1,253	4,699
	O&M	0	0	0	218	779	805	828	848	871	890	5,239	5,239
Total	0	0	940	2,567	779	805	828	1,005	871	2,143	9,938	9,938	
Intermediate treatment													
S/P	Investment												
	Land acquisition	0	0	0	0	0	30	0	0	0	0	0	30
	Design & supervision	0	0	0	0	42	51	0	0	0	0	0	93
	Construction	0	0	0	0	0	0	235	0	0	0	0	235
	Equipment	0	0	0	0	0	0	964	0	0	0	0	964
	total	0	0	0	0	42	81	1,199	0	0	0	0	1,322
	O&M	0	0	0	0	0	0	0	155	155	155	155	465
Total	0	0	0	0	42	81	1,199	155	155	155	155	1,787	
Landfill													
New Tonacatepeque													
	Investment												
	Land acquisition	27	0	0	0	0	0	0	0	0	0	0	27
	Design & supervision	135	90	36	39	0	0	0	0	0	0	0	300
	Construction	0	0	526	788	0	0	0	0	0	0	0	1,314
	Equipment	0	0	0	808	0	0	0	0	0	0	0	808
	total	162	90	562	1,635	0	0	0	0	0	0	0	2,449
	O&M	0	0	0	0	56	56	56	56	56	56	56	336
Total	162	90	562	1,635	56	56	56	56	56	56	56	2,785	
Municipal Solid Waste Total													
	Investment												
	Land acquisition	27	469	0	0	0	30	0	0	0	0	0	526
	Design & supervision	239	223	163	212	42	51	0	8	0	60	0	998
	Construction	0	0	2,605	1,942	0	0	235	0	0	0	0	4,782
	Equipment	0	0	1,150	3,348	0	0	964	149	0	1,193	0	6,804
	total	266	692	3,918	5,502	42	81	1,199	157	0	1,253	0	13,110
	O&M	0	0	0	312	1,068	1,094	1,117	1,292	1,315	1,334	1,334	7,532
Total	266	692	3,918	5,814	1,110	1,175	2,316	1,449	1,315	2,587	2,587	20,642	
Medical Waste Treatment													
	Investment												
	Land acquisition		105										105
	Design & supervision	468	572										1,040
	Construction			284									284
	Equipment			1,366								84	1,450
	total	468	677	1,650	0	0	0	0	0	0	0	84	2,879
	O&M	0	0	0	202	202	202	202	202	202	202	202	1,414
Total	468	677	1,650	202	202	202	202	202	202	202	286	4,293	

Year	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	Total
Municipal & Medical Total											
Investment											
Land acquisition	27	574	0	0	0	30	0	0	0	0	631
Design & supervision	707	795	163	212	42	51	0	8	0	60	2,038
Construction	0	0	2,889	1,942	0	0	235	0	0	0	5,066
Equipment	0	0	2,516	3,348	0	0	964	149	0	1,277	8,254
total	734	1,369	5,568	5,502	42	81	1,199	157	0	1,337	15,989
O&M	0	0	0	514	1,270	1,296	1,319	1,494	1,517	1,536	8,946
Total	734	1,369	5,568	6,016	1,312	1,377	2,518	1,651	1,517	2,873	24,935

8.3.2.2 Individual Management System

a. Storage

Cost required for the container collection system is estimated on the basis of the conditions below.

Target population: 5% of the total population⁶

Container: metal type, 2m³

Maintenance: 3% of investment annually

⁶ According to the POS report by IUDOP, UCA, the marginal population is 13% of the total population. The container collection system targets 40% of the marginal population, i.e., 5% of the total population (13% x 40% = 5%).

Table 8-43: Cost of Container Collection System

		2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	Total
San Salvador												
required number of containers	unit	221	230	239	248	257	266	275	284	291	300	-
operatable containers	unit	92	221	138	239	248	257	266	146	275	190	-
purchase of containers	unit	129	9	101	9	9	9	9	138	16	110	539
Investment cost	US\$	112,243	7,831	87,880	7,831	7,831	7,831	7,831	120,074	13,922	95,711	468,985
O&M cost	US\$	5,769	6,004	6,239	6,474	6,709	6,944	7,179	7,413	7,596	7,831	68,158
Total cost	US\$	118,012	13,835	94,119	14,305	14,540	14,775	15,010	127,487	21,518	103,542	537,143
Mejicanos												
required number of containers	unit	33	33	35	36	36	38	38	39	41	41	-
operatable containers	unit	8	33	25	35	36	36	38	13	39	31	-
purchase of containers	unit	25	0	10	1	0	2	0	26	2	10	76
Investment cost	US\$	21,753	0	8,701	870	0	1,740	0	22,623	1,740	8,701	66,128
O&M cost	US\$	861	861	914	940	940	992	992	1,018	1,070	1,070	9,658
Total cost	US\$	22,614	861	9,615	1,810	940	2,732	992	23,641	2,810	9,771	75,786
Ciudad Delgado												
required number of containers	unit	14	15	15	15	17	17	17	17	18	18	-
operatable containers	unit	7	14	8	15	15	17	17	10	16	11	-
purchase of containers	unit	7	1	7	0	2	0	0	7	2	7	33
Investment cost	US\$	6,091	870	6,091	0	1,740	0	0	6,091	1,740	6,091	28,714
O&M cost	US\$	365	392	392	392	444	444	444	444	470	470	4,257
Total cost	US\$	6,456	1,262	6,483	392	2,184	444	444	6,535	2,210	6,561	32,971
Cuscatancingo												
required number of containers	unit	12	12	14	14	14	14	14	15	15	15	-
operatable containers	unit	6	12	6	14	14	14	14	8	15	7	-
purchase of containers	unit	6	0	8	0	0	0	0	7	0	8	29
Investment cost	US\$	5,221	0	6,961	0	0	0	0	6,091	0	6,961	25,234
O&M cost	US\$	313	313	365	365	365	365	365	392	392	392	3,627
Total cost	US\$	5,534	313	7,326	365	365	365	365	6,483	392	7,353	28,861
Ayutuxtepeque												
required number of containers	unit	5	5	5	5	6	6	6	6	6	6	-
operatable containers	unit	8	8	0	5	5	6	6	6	6	1	-
purchase of containers	unit	0	0	5	0	1	0	0	0	0	5	11
Investment cost	US\$	0	0	4,351	0	870	0	0	0	0	4,351	9,572
O&M cost	US\$	131	131	131	131	157	157	157	157	157	157	1,466
Total cost	US\$	131	131	4,482	131	1,027	157	157	157	157	4,508	11,038
San Marcos												
required number of containers	unit	15	15	15	17	17	17	17	18	18	18	-
operatable containers	unit	6	15	9	15	17	17	17	8	18	12	-
purchase of containers	unit	9	0	6	2	0	0	0	10	0	6	33
Investment cost	US\$	7,831	0	5,221	1,740	0	0	0	8,701	0	5,221	28,714
O&M cost	US\$	392	392	392	444	444	444	444	470	470	470	4,362
Total cost	US\$	8,223	392	5,613	2,184	444	444	444	9,171	470	5,691	33,076
Nueva San Salvador												
required number of containers	unit	39	41	42	44	45	45	47	48	50	50	-
operatable containers	unit	28	39	13	42	44	45	45	36	46	21	-
purchase of containers	unit	11	2	29	2	1	0	2	12	4	29	92
Investment cost	US\$	9,571	1,740	25,233	1,740	870	0	1,740	10,441	3,480	25,233	80,048
O&M cost	US\$	1,018	1,070	1,096	1,148	1,175	1,175	1,227	1,253	1,305	1,305	11,772
Total cost	US\$	10,589	2,810	26,329	2,888	2,045	1,175	2,967	11,694	4,785	26,538	91,820
Antiguo Cuscatlan												
required number of containers	unit	20	20	21	21	23	23	24	24	26	26	-
operatable containers	unit	2	20	18	21	21	23	23	6	24	23	-
purchase of containers	unit	18	0	3	0	2	0	1	18	2	3	47
Investment cost	US\$	15,662	0	2,610	0	1,740	0	870	15,662	1,740	2,610	40,894
O&M cost	US\$	522	522	548	548	600	600	626	626	679	679	5,950
Total cost	US\$	16,184	522	3,158	548	2,340	600	1,496	16,288	2,419	3,289	46,844

		2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	Total
Soyapango												
required number of containers	unit	60	63	65	68	69	72	74	77	78	80	-
operatable containers	unit	29	60	34	65	68	69	72	43	74	47	-
purchase of containers	unit	31	3	31	3	1	3	2	34	4	33	145
Investment cost	US\$	26,973	2,610	26,973	2,610	870	2,610	1,740	29,583	3,480	28,713	126,162
O&M cost	US\$	1,566	1,644	1,697	1,775	1,801	1,879	1,931	2,010	2,036	2,088	18,427
Total cost	US\$	28,539	4,254	28,670	4,385	2,671	4,489	3,671	31,593	5,516	30,801	144,589
Ilopango												
required number of containers	unit	20	21	21	21	23	23	24	24	24	26	-
operatable containers	unit	6	20	15	21	21	23	23	10	23	18	-
purchase of containers	unit	14	1	6	0	2	0	1	14	1	8	47
Investment cost	US\$	12,181	870	5,221	0	1,740	0	870	12,181	870	6,961	40,894
O&M cost	US\$	522	548	548	548	600	600	626	626	626	679	5,923
Total cost	US\$	12,703	1,418	5,769	548	2,340	600	1,496	12,807	1,496	7,640	46,817
San Martin												
required number of containers	unit	12	12	12	12	12	14	14	14	14	14	-
operatable containers	unit	0	12	12	12	12	12	14	2	14	14	-
purchase of containers	unit	12	0	0	0	0	2	0	12	0	0	26
Investment cost	US\$	10,441	0	0	0	0	1,740	0	10,441	0	0	22,622
O&M cost	US\$	313	313	313	313	313	365	365	365	365	365	3,390
Total cost	US\$	10,754	313	313	313	313	2,105	365	10,806	365	365	26,012
Apopa												
required number of containers	unit	21	23	23	23	24	24	26	26	26	27	-
operatable containers	unit	19	21	4	23	23	24	24	24	24	7	-
purchase of containers	unit	2	2	19	0	1	0	2	2	2	20	50
Investment cost	US\$	1,740	1,740	16,532	0	870	0	1,740	1,740	1,740	17,402	43,504
O&M cost	US\$	548	600	600	600	626	626	679	679	679	705	6,342
Total cost	US\$	2,288	2,340	17,132	600	1,496	626	2,419	2,419	2,419	18,107	49,846
Nejapa												
required number of containers	unit	2	3	3	3	3	3	3	3	3	3	-
operatable containers	unit	0	2	3	3	3	3	3	1	2	3	-
purchase of containers	unit	2	1	0	0	0	0	0	2	1	0	6
Investment cost	US\$	1,740	870	0	0	0	0	0	1,740	870	0	5,220
O&M cost	US\$	52	78	78	78	78	78	78	78	78	78	754
Total cost	US\$	1,792	948	78	78	78	78	78	1,818	948	78	5,974
Tonacatepeque												
required number of containers	unit	11	11	11	11	11	11	12	12	12	12	-
operatable containers	unit	0	11	11	11	11	11	11	1	12	12	-
purchase of containers	unit	11	0	0	0	0	0	1	11	0	0	23
Investment cost	US\$	9,571	0	0	0	0	0	870	9,571	0	0	20,012
O&M cost	US\$	287	287	287	287	287	287	313	313	313	313	2,974
Total cost	US\$	9,858	287	287	287	287	287	1,183	9,884	313	313	22,986
Total cost												
required number of containers	unit	485	504	521	538	557	573	591	607	622	636	-
operatable containers	unit	211	488	296	521	538	557	573	314	588	397	-
purchase of containers	unit	277	19	225	17	19	16	18	293	34	239	1,157
Investment cost	US\$	241,018	16,531	195,774	14,791	16,531	13,921	15,661	254,939	29,582	207,955	1,006,703
O&M cost	US\$	12,659	13,155	13,600	14,043	14,539	14,956	15,426	15,844	16,236	16,602	147,060
Total cost	US\$	253,677	29,686	209,374	28,834	31,070	28,877	31,087	270,783	45,818	224,557	1,153,763

b. Collection

Cost required for the collection is estimated on the basis of the conditions below.

- 18yd³ compactors cover 85% of total collection amount, and 11yd³ compactors cover 15%.
- 10 % of collection efficiency is raised by the collection route improvement, i.e.,

18yd³ compactor: 2.621 ton/hour → 2.883 ton/hour

11yd³ compactor: 1.998 ton/hour → 2.198 ton/hour

- Number of trips is determined by distances from the each municipality to a corresponding destination such as T/S-1, T/S-2, Nejapa SL and Tonacatepeque SL.

Table 8-44: Number of Collection Vehicle

Unit: nos.

Year	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	Total	
San Salvador												
required number of vehicle	18yd ³	55	56	59	56	47	48	49	50	53	54	
	11yd ³	12	13	14	13	11	11	11	12	12	12	
operatable vehicle	18yd ³	36	44	8	45	45	47	48	41	50	16	
	11yd ³	5	11	6	11	11	11	11	5	12	7	
purchase of vehicle	18yd ³	8	0	37	0	2	1	1	9	3	38	99
	11yd ³	6	0	5	0	0	0	0	7	0	5	23
Mejicanos												
required number of vehicle	18yd ³	7	7	8	8	6	6	6	7	7	7	
	11yd ³	2	2	2	2	1	2	2	2	2	2	
operatable vehicle	18yd ³	5	6	1	6	6	6	6	5	7	2	
	11yd ³	2	2	0	1	1	1	2	2	2	1	
purchase of vehicle	18yd ³	1	0	5	0	0	0	0	2	0	5	13
	11yd ³	0	0	1	0	0	1	0	0	0	1	3
Ciudad Delgado												
required number of vehicle	18yd ³	3	3	3	3	4	4	4	4	4	4	
	11yd ³	1	1	1	1	1	1	1	1	1	1	
operatable vehicle	18yd ³	5	5	0	3	3	4	4	4	4	1	
	11yd ³	2	2	0	1	1	1	1	1	1	0	
purchase of vehicle	18yd ³	0	0	3	0	1	0	0	0	0	3	7
	11yd ³	0	0	1	0	0	0	0	0	0	1	2
Cuscatancingo												
required number of vehicle	18yd ³	3	3	3	4	2	2	3	3	3	3	
	11yd ³	1	1	1	1	1	1	1	1	1	1	
operatable vehicle	18yd ³	3	2	0	2	2	2	2	3	3	1	
	11yd ³	1	1	0	1	1	1	1	1	1	0	
purchase of vehicle	18yd ³	0	0	2	0	0	0	1	0	0	2	5
	11yd ³	0	0	1	0	0	0	0	0	0	1	2
Ayutuxtepeque												
required number of vehicle	18yd ³	1	1	1	1	1	1	1	1	1	1	
	11yd ³	0	0	0	0	0	0	0	0	0	0	
operatable vehicle	18yd ³	1	1	0	1	1	1	1	1	1	0	
	11yd ³	0	0	0	0	0	0	0	0	0	0	
purchase of vehicle	18yd ³	0	0	1	0	0	0	0	0	0	1	2
	11yd ³	0	0	0	0	0	0	0	0	0	0	0
San Marcos												
required number of vehicle	18yd ³	4	4	5	5	3	3	3	3	3	3	
	11yd ³	1	1	1	1	1	1	1	1	1	1	
operatable vehicle	18yd ³	2	3	1	3	3	3	3	2	3	1	
	11yd ³	1	1	0	1	1	1	1	1	1	0	
purchase of vehicle	18yd ³	1	0	2	0	0	0	0	1	0	2	6
	11yd ³	0	0	1	0	0	0	0	0	0	1	2
Nueva San Salvador												
required number of vehicle	18yd ³	11	11	12	7	8	8	8	8	8	9	
	11yd ³	3	3	3	2	2	2	2	2	2	2	
operatable vehicle	18yd ³	4	7	3	7	7	8	8	5	8	4	
	11yd ³	1	2	1	2	2	2	2	1	2	1	
purchase of vehicle	18yd ³	3	0	4	0	1	0	0	3	0	5	16
	11yd ³	1	0	1	0	0	0	0	1	0	1	4

Year		2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	Total
Antiguo Cuscatlan												
required number of vehicle	18yd ³	5	5	6	4	4	4	4	4	4	4	4
	11yd ³	1	1	1	1	1	1	1	1	1	1	1
operatable vehicle	18yd ³	1	4	3	4	4	4	4	1	4	3	
	11yd ³	1	1	0	1	1	1	1	1	1	0	
purchase of vehicle	18yd ³	3	0	1	0	0	0	0	3	0	1	8
	11yd ³	0	0	1	0	0	0	0	0	0	1	2
Soyapango												
required number of vehicle	18yd ³	15	16	16	17	12	12	12	13	13	13	
	11yd ³	4	4	4	4	3	3	3	3	3	3	
operatable vehicle	18yd ³	10	12	2	12	12	12	12	10	13	3	
	11yd ³	3	3	0	3	3	3	3	3	3	0	
purchase of vehicle	18yd ³	2	0	10	0	0	0	0	3	0	10	25
	11yd ³	0	0	3	0	0	0	0	0	0	3	6
Ilopango												
required number of vehicle	18yd ³	6	6	6	6	4	4	4	4	4	5	
	11yd ³	1	1	1	1	1	1	1	1	1	1	
operatable vehicle	18yd ³	4	4	0	4	4	4	4	4	4	0	
	11yd ³	1	1	0	1	1	1	1	1	1	0	
purchase of vehicle	18yd ³	0	0	4	0	0	0	0	0	0	5	9
	11yd ³	0	0	1	0	0	0	0	0	0	1	2
San Martin												
required number of vehicle	18yd ³	2	2	2	2	3	3	3	3	3	3	
	11yd ³	0	0	1	1	1	1	1	1	1	1	
operatable vehicle	18yd ³	3	3	0	2	2	3	3	3	3	1	
	11yd ³	1	1	0	1	1	1	1	1	1	0	
purchase of vehicle	18yd ³	0	0	2	0	1	0	0	0	0	2	5
	11yd ³	0	0	1	0	0	0	0	0	0	1	2
Apopa												
required number of vehicle	18yd ³	4	4	4	4	4	5	5	5	5	5	
	11yd ³	1	1	1	1	1	1	1	1	1	1	
operatable vehicle	18yd ³	4	4	0	4	4	4	5	5	5	1	
	11yd ³	1	1	0	1	1	1	1	1	1	0	
purchase of vehicle	18yd ³	0	0	4	0	0	1	0	0	0	4	9
	11yd ³	0	0	1	0	0	0	0	0	0	1	2
Nejapa												
required number of vehicle	18yd ³	1	1	1	1	1	1	1	1	1	1	
	11yd ³	0	0	0	0	0	0	0	0	0	0	
operatable vehicle	18yd ³	1	1	0	1	1	1	1	1	1	0	
	11yd ³	1	1	0	0	0	0	0	0	0	0	
purchase of vehicle	18yd ³	0	0	1	0	0	0	0	0	0	1	2
	11yd ³	0	0	0	0	0	0	0	0	0	0	0
Tonacatepeque												
required number of vehicle	18yd ³	2	2	2	2	2	2	2	2	2	2	
	11yd ³	0	0	0	0	0	0	0	1	1	1	
operatable vehicle	18yd ³	2	2	0	2	2	2	2	2	2	0	
	11yd ³	0	0	0	0	0	0	0	0	1	1	
purchase of vehicle	18yd ³	0	0	2	0	0	0	0	0	0	2	4
	11yd ³	0	0	0	0	0	0	0	1	0	0	1
Total												
required number of vehicle	18yd ³	119	121	128	120	101	103	105	108	111	114	
	11yd ³	27	28	30	28	24	25	25	27	27	27	
operatable vehicle	18yd ³	81	98	18	96	96	101	103	87	108	33	
	11yd ³	20	27	7	24	24	24	25	18	27	10	
purchase of vehicle	18yd ³	18	0	78	0	5	2	2	21	3	81	210
	11yd ³	7	0	17	0	0	1	0	9	0	17	51

Table 8-45: Collection Cost

Unit: US\$ 1,000

year	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	Total
San Salvador											
Investment	1,253	0	4,013	0	196	98	98	1,430	294	4,111	11,493
O&M	2,506	2,598	2,706	2,571	2,022	2,093	2,157	2,229	2,307	2,368	23,557
total	3,759	2,598	6,719	2,571	2,218	2,191	2,255	3,659	2,601	6,479	35,050
Mejicanos											
Investment	98	0	568	0	0	78	0	196	0	568	1,508
O&M	326	333	344	352	261	271	275	282	289	296	3,029
total	424	333	912	352	261	349	275	478	289	864	4,537
Ciudad Delgado											
Investment	0	0	372	0	98	0	0	0	0	372	842
O&M	139	143	150	153	157	161	165	168	172	175	1,583
total	139	143	522	153	255	161	165	168	172	547	2,425
Cuscatancingo											
Investment	0	0	274	0	0	0	98	0	0	274	646
O&M	147	158	158	166	105	105	109	109	112	116	1,285
total	147	158	432	166	105	105	207	109	112	390	1,931
Ayutuxtepeque											
Investment	0	0	98	0	0	0	0	0	0	98	196
O&M	44	44	51	51	51	55	55	55	55	58	519
total	44	44	149	51	51	55	55	55	55	156	715
San Marcos											
Investment	98	0	274	0	0	0	0	98	0	274	744
O&M	198	205	209	217	123	126	130	133	133	137	1,611
total	296	205	483	217	123	126	130	231	133	411	2,355
Nueva San Salvador											
Investment	372	0	470	0	98	0	0	372	0	568	1,880
O&M	501	520	532	318	328	336	346	353	360	370	3,964
total	873	520	1,002	318	426	336	346	725	360	938	5,844
Antiguo Cuscatlan											
Investment	294	0	176	0	0	0	0	294	0	176	940
O&M	245	252	260	148	152	158	162	165	169	179	1,890
total	539	252	436	148	152	158	162	459	169	355	2,830
Soyapango											
Investment	196	0	1,214	0	0	0	0	294	0	1,214	2,918
O&M	698	725	754	777	492	503	520	538	551	568	6,126
total	894	725	1,968	777	492	503	520	832	551	1,782	9,044
Ilopango											
Investment	0	0	470	0	0	0	0	0	0	568	1,038
O&M	256	260	268	279	173	176	183	187	190	194	2,166
total	256	260	738	279	173	176	183	187	190	762	3,204
San Martin											
Investment	0	0	274	0	98	0	0	0	0	274	646
O&M	76	79	82	86	112	115	119	119	126	130	1,044
total	76	79	356	86	210	115	119	119	126	404	1,690
Apopa											
Investment	0	0	470	0	0	98	0	0	0	470	1,038
O&M	170	174	180	188	192	195	202	206	209	213	1,929
total	170	174	650	188	192	293	202	206	209	683	2,967
Nejapa											
Investment	0	0	98	0	0	0	0	0	0	98	196
O&M	17	17	17	17	17	17	21	21	21	21	186
total	17	17	115	17	17	17	21	21	21	119	382

year	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	Total
Tonacatepeque											
Investment	0	0	196	0	0	0	0	78	0	196	470
O&M	69	69	72	72	76	80	80	87	87	87	779
total	69	69	268	72	76	80	80	165	87	283	1,249
Total											
Investment	2,311	0	8,967	0	490	274	196	2,762	294	9,261	24,555
O&M	5,392	5,577	5,783	5,395	4,261	4,391	4,524	4,652	4,781	4,912	49,668
total	7,703	5,577	14,750	5,395	4,751	4,665	4,720	7,414	5,075	14,173	74,223

c. Road Sweeping

Cost required for the street sweeping is estimated on the basis of the conditions below.

- Basically manual sweeping is adapted, only San Salvador employs mechanical road sweepers the same as at present.
- Street length covered by the sweeping does not change from the present.
- Street sweepers are appropriately deployed, i.e., 1km/sweeper.

Table 8-46: Road Sweeping Cost (Manual Sweeping)

Unit: US\$/year

	length (km)	nos. of workers	personnel total (US\$)	nos. of handcarts*	handcart total (US\$)	Total (US\$)	Total (US\$ 1,000)
San Salvador	269.5	299	1,127,798	59.8	4,192	1,131,990	1,132
Mejicanos	29.1	32	120,701	6.4	448	121,149	121
Ciudad Delgado	15.0	17	64,122	3.4	238	64,360	64
Cuscatancingo	9.0	10	37,719	2.0	140	37,859	38
Ayutuxtepeque	2.7	3	11,316	0.6	42	11,358	11
San Marcos	7.0	8	30,175	1.6	112	30,287	30
Nueva San Salvador	43.1	48	181,051	9.6	673	181,724	182
Antiguo Cuscatlan	51.6	57	214,998	11.4	799	215,797	216
Soyapango	12.6	14	52,807	2.8	197	53,004	53
Ilopango	1.8	2	7,544	0.4	28	7,572	8
San Martin	1.7	2	7,544	0.4	28	7,572	8
Apopa	5.6	6	22,631	1.2	84	22,715	23
Nejapa	0.7	1	3,772	0.2	14	3,786	4
Tonacatepeque	3.2	4	15,088	0.8	56	15,144	15
Total	452.6	503	1,897,266	100.6	7,052	1,904,318	1,905

Note: * Number of handcarts required to be purchased every year.

Table 8-47: Road Sweeping Cost (Mechanical Sweeping, San Salvador only)

Unit: US\$ 1,000

year	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	Total
Nos. of vehicle	5	5	5	5	5	5	5	5	5	5	
Nos. of purchase			2		3					2	7
Investment	0	0	258	0	387	0	0	0	0	258	903
O&M	91	91	91	91	91	91	91	91	91	91	910
Total	91	91	349	91	478	91	91	91	91	349	1,813

8.4 Evaluation of the Master Plan

8.4.1 Technical Evaluation

The M/P proposes the following as the regional system:

- Transfer stations and trailer transport;
- A selection plant;
- Tonacatepeque sanitary landfill; and
- Medical waste incineration plant.

Meanwhile, the following are proposed for the individual municipal SWM system:

- Stepwise introduction of separate collection;
- Collection service coverage expansion; and
- implementation of final disposal at sanitary landfills.

a. Regional System

a.1 Transfer Stations and Trailer Transport (T/S&T)

The T/S&T is the system that wastes collected by collection vehicles are transferred to large-size trailers and the trailers carry the waste to respective destination. It is judged that this T/S&T system is quite conventional technology and therefore is enforceable in AMSS based on the technologies currently available in the country and/or by procuring some technical inputs from foreign countries at competitive prices.

However, attentions should be paid that it is the first experience for El Salvador to implement said system for municipal SW transfer. Therefore, careful planning in this respect becomes necessary. The M/P proposes that the 350ton/day T/S with trailer transport should firstly be constructed and operated in year 2004 and its experiences should be utilized for the succeeding construction and operation of the larger T/S (900ton/day capacity) from the succeeding year 2005.

Meanwhile, it is also judged that El Salvador reserves sufficient technical background to implement reliable O&M activities based on their own efforts. Accordingly, it is judged that construction, operation and maintenance of the T/S&T system is feasible from technical viewpoints.

a.2 Selection Plant (S/P)

The principal objective of selection plant (S/P) is to realize “resource conservation”, which is one of the M/P goals, by achieving high efficiency in the material recovery activities. Therefore, the Study proposes the recycling system (system of S/P for separate collection) which aims a high ratio of resource recovery, whose technical system concept is different from that of the S/P proposed by MIDES.

The Study’s proposal supported by international experiences and trends suggests that present recycling practices that collection workers and/or waste pickers recover recyclable from mixed wastes would gradually reduce and in return “resource recovery from separate collection” would gradually increase, especially when economies are growing. Therefore, the M/P disagrees to the introduction of S/P in the near future fed with mixed waste that MIDES proposes. The M/P proposes the construction and operation of the S/P around year 2008 when all 14 municipalities introduce the separate collection activities.

The S/P that the M/P proposes consists of facilities such as feeding conveyor, magnetic separator, hand-sorting conveyor etc. that could be constructed operated and maintained based on the locally available technical supports and by some technical inputs procured internationally at competitive prices. The technologies required for this S/P are prevalent and conventional.

a.3 Tonacatepeque Final Disposal Site

As the “Special Regulation on Integral Solid Waste Management (Reglamento Especial sobre el Manejo Integral de los Desechos Sólidos)” was published on 1st June 2000, it becomes necessary to have final disposal sites that comply with this regulation. MIDES Nejapa final disposal site was constructed in 1999 and has already been operated in AMSS. Therefore, it is judged that technical requirements for the Tonacatepeque final disposal site can be fulfilled by the technologies experienced and reserved by the Salvadorans together with some technical inputs from foreign countries.

As for O&M aspects of the sanitary landfill, it is judged that the Salvadorans are capable of operating and maintaining S/L by themselves by referring current O&M of MIDES Nejapa S/L and/or foreign S/L cases.

a.4 Medical Waste Incinerator

Construction, operation and maintenance of medical waste incinerator requires considerably high technologies that are unfortunately absent in El Salvador. Therefore, it is necessary for its construction operation and maintenance to import international technologies.

Accordingly, the M/P proposes to have three years period of preparation: namely the period for the Salvadoran authority to examine and investigate how to procure said technologies at competitive prices and have those technologies take root in the country. The M/P consequently recommends start the medical waste incinerator operation from year 2004.

b. Individual System

b.1 Discharge and Storage System

As for the discharge and storage system, the M/P proposes stepwise improvement of:

- step 1 “improvement of hygienic condition of discharge areas”;
- step 2 “implementation of pilot projects for separate collection”; and
- step 3 “implementation of separate collection”.

In view of technical requirements, it is judged that the steps can be attained by the technical practices prevalent in AMSS. Plans to implement in a stepwise manner would be considered important.

b.2 Collection

The basic principle of the M/P for the collection component is: to improve the collection works efficiency based on the current technologies; and the surplus collection capacity gained from this improvement should be forwarded to expand the collection services.

This collection efficiency improvement is achievable by the Salvadoran efforts, if the “Manual for the Collection Route Optimization” produced by the Study is actually utilized in their route improvement practices.

b.3 Final Disposal

A final disposal site that already complies with the recent environmental regulation is the MIDES Nejapa S/L that 10 municipalities are its users. Meanwhile, it is known that the municipalities of Cuscatancingo and Antiguo Cuscatlan are going to use the New ESPIGA S/L that is supposed to be constructed in the near future. Hence, the Study carried out the conceptual design and cost estimate of the Tonacatepeque Sanitary Landfill, in responding such request made by OPAMSS/COAMSS, which is to be used by the municipalities of Tonacatepeque and San Martin.

When these new two S/Ls are constructed in the near future, AMSS will have 3 regional S/Ls in total that comply the environmental regulation. It consequently will contribute the environmental conservation in AMSS. Furthermore, it will raise the technical safety factor of final disposal management in AMSS than can be fully cope with the emergency and accident occasions.